

## REMARKS

### Grounds of Rejections

Claims 1-17 and 58-64 are pending. Claims 3 and 6-8 have been withdrawn from consideration.

Claims 1, 4, 5, 9-12, 14-17 and 62-64 have been rejected under 35 USC 103(a) as being unpatentable over Yew et al. (US Patent No. 6,137,164).

Claims 1, 4, 5, 9-12, 14-17 and 62-64 have been rejected under 35 USC 103(a) as being unpatentable over Yew et al. (US Patent No. 6,137,164) and further in combination with Yoneda et al. (US Patent Publication No. 20030006503).

Claim 2 has been rejected under 35 USC 103(a) as being unpatentable over Yew et al., or Yew et al. and Yoneda et al., and further in combination with Hanaoka et al. (US Patent Publication 20020030245).

Claims 58-61 have been rejected under 35 USC 103(a) as being unpatentable over Yew et al. (US Patent No. 6,137,164) and further in combination with Hanaoka et al. (US Patent Publication 20020030245).

Claim 12 has been rejected under 35 USC 103(a) as being unpatentable over Yew et al. and Hanaoka et al. and further in combination with Yoneda et al. (US Patent Publication No. 20030006503).

Claims 9-13 have been rejected under 35 USC 103(a) as being unpatentable over Hanaoka et al. (US Patent Publication 20020030245).

Claim 12 has been rejected under 35 USC 103(a) as being unpatentable over Hanaoka et al. and Yoneda et al.

### Summary Of Claimed Subject Matter

Claims 1-18 are directed to a semiconductor package 50 (Figure 2A). Claims 58-64 are directed to an assembly 130 (Figure 8A) that includes the package 50 (Figure 2A).

The package 50 (Figure 2A) includes a substrate 54, a semiconductor die 52 mounted to the substrate 54, and an encapsulant 48 molded to the substrate 54 encapsulating the die 52. The substrate 54 includes die contacts 86 that are placed in electrical communication with bond pads 60 on the die 52. The substrate 54 also includes conductors 72 (Figure 2B) and bonding sites 66 in electrical communication with the die contacts 86.

The package 50 (Figure 2A) also includes external contacts 84 on the bonding sites 66 arranged in an area array. The external contacts 84 comprise multi layered metal bumps that include a base layer 88 (first layer) on the bonding sites 66, a bump layer 90 (metal bump in the amended claims) on the base layer 88, and an outer layer 92 (third layer) on the bump layer 90. In addition to the external contacts 84 comprising multi layered metal bumps, the die contacts 86 also comprise multi layered metal bumps having substantially the same configuration.

### 35 USC §103(a) Rejections Of Claims 1, 4, 5, 9-12, 14-17 And 62-64 Over Yew et al.

These 35 USC §103(a) rejections are traversed, as neither Yew et al., or the incorporated reference Abbott et al., teach or suggest all of the features of the present claims. However, independent claims 1, 9, 14 and 62 have been amended to include additional recitations which further distinguish the claimed component from the cited art.

In evaluating the claims for unobviousness the Examiner is asked to view the claims "as a whole", and from the viewpoint of one skilled in the art at the time of

the invention. In this regard, please compare the semiconductor component 50 shown in Figure 2A of the present application, with the semiconductor component shown in Figures 4A-4B of Yew et al. In addition to the overall non similarity of the two components, the following individual differences are noted.

The present component 50 (Figure 2A) has external contacts 84 (Figure 2A) in the form of multi layer metal bumps with planar tips. In addition, the present component 50 (Figure 2A) includes conductors 72 (Figure 2A) which connect the external contacts in an area array. The presently claimed external contacts 84 are smaller, denser, and provide more planarity than conventional solder ball external contacts. In contrast, the component in Yew et al. includes external contacts (solder balls 440-Figure 4A) in the form of conventional solder balls having diameters of 0.4mm to 0.75mm (column 6, line 61). Even if these solder balls are made with multiple layers as taught by Abbott et al., they are still large round balls without planar surfaces.

The present component also includes conductors 72 (Figure 2B), which interconnect the external contacts 84 in an area array. In Yew et al. there are no conductors, and the external contacts are not in an area array, as the back side chip 402 (Figure 4A) covers the back side of the substrate 420.

The present component also includes die contacts 86 (Figure 2A) which also comprise multi layer metal bumps with planar surfaces. The Examiner has characterized the electrical terminals 411, 630 in Yew et al. as anticipating the presently claimed die contacts. However, there is no suggestion in Yew et al. of making these terminals 411, 630 as multi layered metal bumps having planar surfaces. Rather Yew et al. teaches conductive balls 630 (Figure 6A and column 7, line 16).

Amended independent claim 1 recites the features of the external contacts which comprise multi layer metal bumps with planar surfaces, conductors which connect the external contacts in an area array, and die contacts which comprise multi layer metal bumps with planar surfaces. These features in combination are submitted to define a component which "taken as a whole" is unobvious over the art.

Amended independent claim 9 recites "each die contact and each external contact comprises a base metal layer, a pyramidally shaped metal bump on the base metal layer and a non-oxidizing outer metal layer on the metal bump". Amended independent claim 9 also recites "each external contact having a height less than that of a solder ball external contact having a diameter of from 0.3 mm to 0.762 mm." Antecedent basis for this recitation is contained on page 4, line 5, and on page 10, lines 31-35 of the specification.

The Examiner has characterized size recitations as being obvious design choices. However, in the presently claimed component the size differences result from unobvious structures. In the present case, the goal is a thinner component, and it is accomplished with external contacts in the form of metal bumps with planar surfaces. As the prior art teaches conventional solder ball external contacts, the present external contacts have more than just a reduced size. Specifically, the external contacts have a structure which achieves the stated function of reduced size.

Amended independent claim 14 also recites the feature of die contacts and external contacts which comprise multi layered metal bumps with planar surfaces. In addition, claim 14 recites "a spacing S of the external contacts substantially larger than the spacing of solder ball external contacts having a diameter of from 0.3 mm to 0.762

mm". Antecedent basis for this recitation is contained on page 4, line 5, and on page 11, lines 4-12 of the specification. Claim 14 also recites the feature of conductors with bonding sites for the terminal contacts in an area array.

Amended independent claim 62 also recites the feature of die contacts and external contacts which comprise multi layered metal bumps. Claim 62 also recites "each external contact having a height H on the substrate less than that of solder ball external contacts having a diameter of from 0.3 mm to 0.762 mm, and a spacing S substantially larger than that of the solder ball external contacts." Antecedent basis for this recitation is contained on page 4, line 5, on page 10, lines 31-35, and on page 11, lines 4-12 of the specification. Claim 62 also recites the feature of conductors with bonding sites for the terminal contacts in an area array.

As amended independent claims 1, 9, 14 and 62 include the above noted recitations, the claims "taken as a whole" are submitted to be unobvious over Yew et al., and unobvious over the prior art in general. In addition, the Examiner is asked to view the claims from the viewpoint of one skilled in the art at the time of the invention, rather than from the viewpoint of an experienced Examiner. Further, although the Examiner has used well established legal precedent to advantage in rejecting claims, assessments of unobviousness and application of the legal precedents are not as clear cut as the Office Action indicates. In this regard, Applicant's assertion of unobviousness is also supported by legal precedents.

35 USC §103(a) Rejections Of Claims 1, 4, 5, 9-12, 14-17 And 62-64 Over Yew et al. and Yoneda et al.

With respect to these 35 USC §103(a) rejections, the arguments stated above with respect to independent claims

1, 9, 14 and 62 having features not disclosed by Yew et al. and Abbott et al. are restated.

Yoneda et al. was cited as teaching at paragraph 470 "a process wherein bumps 342 having an inherent height H are selected to reduce an overall thickness T1 of a "package". In addition it would have been obvious to use this process to provide the bumps of Yew because, as disclosed by Yoneda as cited, it would provide a thinner package".

Admittedly reduced thickness in a component is a goal of semiconductor packaging. One skilled in the art need not read the four hundred eighty four paragraphs and one hundred and forty one figures of Yoneda et al. to realize this goal. However, the bumps 342 (Figure 15) in Yoneda et al. are not equivalent to the presently claimed die contacts, which are stated to be multi layered metal bumps with planar surfaces. Rather, the bumps 342 (Figure 15) in Yoneda et al. appear to be conventional solder balls adapted for flip chip bonding (paragraph 470). Further, there is no suggestion of die contacts in combination with external contacts, both of which are multi layered metal bumps with planar surfaces. Thus, although the goal of reduced thickness may be the same, the structure for accomplishing reduced thickness in the present component are different and unobvious over the art.

35 USC §103(a) Rejection Of Claim 2 Over Yew et al., Or Yew et al. And Yoneda et al., And Hanaoka et al.

With respect to this 35 USC §103(a) rejection of dependent claim 2, the arguments stated above with respect to independent claim 1 having features not disclosed by Yew et al., or Yew et al. and Yoneda et al. are restated.

Hanaoka et al. was cited as teaching "die 6 contacts 14 and external (at least external to 6) contacts 14 generally pyramidal in shape; each external contact

comprising a multi layered metal bump including a first metal layer, a second metal layer on the first metal layer, and a non-oxidizing metal layer on the second metal layer".

However, amended independent claim 1 (and independent claim 58 as well) has been amended to change "second metal layer" to "metal bump". In addition, claim 2 has been amended to state that both the die contacts and the external contacts "comprise generally pyramiddally shaped metal bumps". In Hanaoka et al. the conductive layer 14 may be multi layered, but it does not include a metal bump, and does not comprise a multi layer metal bump. Rather, the conductive layer 14 is formed on resin projections 20 (paragraph 130), and solder ball external contacts 24 (paragraph 132) are placed on the projections 20. There is no suggestion in Hanaoka et al. (or in Yew et al.) of die contacts or external contacts in the form of multi layered metal bumps. In addition, the external contacts 24 in Hanaoka et al. would be provide a thicker component, rather than a thinner component, as with the presently claimed die contacts and external contacts.

#### 35 USC §103(a) Rejections Of Claims 58-61 Over Yew et al. And Hanaoka et al.

Independent claim 58 have been amended to include recitations which further distinguish the claims from the combination of Yew et al. and Hanaoka et al. In particular, independent claim 58 has been amended to recite "conductors on a second side thereof in electrical communication with the die contacts having a plurality of bonding sites in an area array". In addition, independent claim 58 recites that the external contacts comprise multi layered metal bumps, each of which includes a metal bump. As previously argued, these features are not taught or

suggested by the combination of Yew et al. and Hanaoka et al.

Independent claim 58 also recites that the external contacts comprise multi layered metal bumps "having second planar tip portions configured to facilitate bonding to the supporting substrate, to reduce a thickness of the package on the supporting substrate, and to insure a planarity of the package on the supporting substrate". The Examiner has characterized this recitation as a statement of intended use.

However, this interpretation is submitted to be incorrect. If a structure is configured to perform a stated function, it is not intended use, but a recitation of structure and function. As held in In re Evanega, 829 F.2d 1110, 4 USPQ2d 1249 (Fed. Cir. 1987), In re Miller, 418 F.2d 1392, 64 USPQ 46 (CCPA 1969) and In re Gulack, 703 F.2d 1381, 217 USPQ 401 (Fed Cir. 1983), claims are to be evaluated as a whole, and all limitations including functional limitations are to be considered.

With regard to this recitation the Examiner also states "Further, because the portions of Yew appear to have the same structure as the claimed portions, they appear to be capable of being used for the intended uses, as the statements of intended use do not patentably distinguish the claimed portions from the portions of Yew." However, as previously argued, the external contacts 440 in Yew et al. do not have the same structure as the presently claimed external contacts, which comprise multi layered metal bumps with planar surfaces. Rather, the external contacts 440 in Yew et al. are solder balls, and the external contacts in Abbott et al. are multi layered balls. In order to emphasize this distinction, claim 58 has been amended to



recite the stated function is "relative to solder ball external contacts".

35 USC §103(a) Rejection Of Claim 12 Over Yew et al. And Hanaoka et al. and Yoneda et al.

With respect to this 35 USC §103(a) rejection of claim 12, amended independent claim 9 includes the above noted recitations that are not disclosed or suggested by the combination of Yew et al., Hanaoka et al., and Yoneda et al. Claim 12 is thus submitted to be unobvious over Yew et al., Hanaoka et al., and Yoneda et al.

Further, Applicant would argue that the size limitation of 5 $\mu$ m for the die contacts and external contacts is not taught or suggested by the cited combination of references. In this regard, the cited combination of references teach solder ball external contacts, which cannot be made as small as 5  $\mu$ m, even with the goal of reduced component thickness. Applicant would therefore argue a critical limitation not disclosed by the prior art.

35 USC §103(a) Rejections Of Claims 9-13 Over Hanaoka et al.

With respect to these 35 USC §103(a) rejections, amended independent claim 9 includes the above noted recitations that are not taught or suggested by Hanaoka et al. In particular, Hanaoka et al. does not teach or suggest die contacts and external contacts in combination, which comprise multi layered metal bumps having planar surfaces and pyramidally shaped metal bumps. In addition, Hanaoka et al. does not teach or suggest external contacts having a height which is less than conventional solder balls with the stated size range.

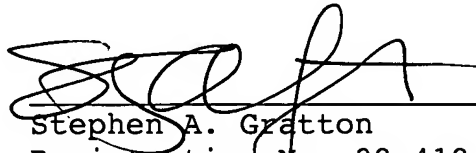
35 USC §103(a) Rejection Of Claim 12 Over Hanaoka et al. and Yoneda et al.

With respect to these 35 USC §103(a) rejections, amended independent claim 9 includes the above noted recitations that are not disclosed or suggested by Hanaoka et al. In addition, the previous arguments of the 5  $\mu$ m recitation being a critical undisclosed limitation are restated.

Conclusion

In view of the amendments and arguments, favorable consideration and allowance of claims 1, 2, 4, 9-17 and 58-64 is requested. In addition, rejoinder of withdrawn dependent claims 3 and 6-8 is requested. Should any issues remain, the Examiner is requested to contact the undersigned by telephone.

Respectfully submitted:

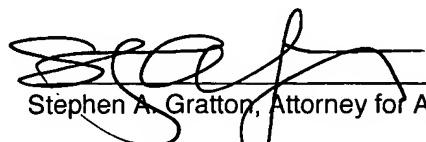
  
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